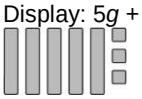
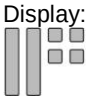
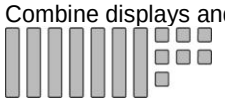
5. **a)** Display: $5g + 3$



Display: $2g + 4$



Combine displays and group like tiles.

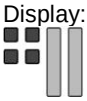


The combined tiles represent $7g + 7$.

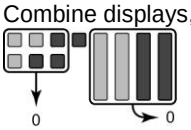
So, $(5g + 3) + (2g + 4) = 5g + 3 + 2g + 4$
$= 5g + 2g + 3 + 4$
$= 7g + 7$

b) Display: $3 - 2j$

Display: $-4 + 2j$

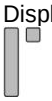


Combine displays, group like tiles, and remove zero pairs.

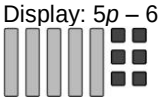


The remaining tiles represent -1.
So, $(3 - 2j) + (-4 + 2j) = 3 - 2j - 4 + 2j$
$= -2j + 2j + 3 - 4$
$= -1$

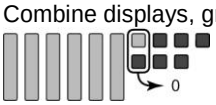
c) Display: $p + 1$



Display: $5p - 6$

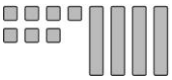


Combine displays, group like tiles, and remove zero pairs.

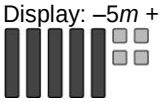


The remaining tiles represent $6p - 5$.
So, $(p + 1) + (5p - 6) = p + 1 + 5p - 6$
$= p + 5p + 1 - 6$
$= 6p - 5$

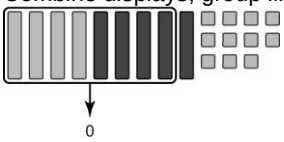
d) Display: $7 + 4m$



Display: $-5m + 4$



Combine displays, group like tiles, and remove zero pairs.



The remaining tiles represent $-m + 11$.

So, $(7 + 4m) + (-5m + 4) = 7 + 4m - 5m + 4$
$= 4m - 5m + 7 + 4$
$= -m + 11$

8. a) $(6x + 3) + (3x + 4)$ Remove brackets.
$= 6x + 3 + 3x + 4$ Group like terms.
$= 6x + 3x + 3 + 4$ Combine like terms.
$= 9x + 7$

b) $(5b - 4) + (2b + 9)$ Remove brackets.
$= 5b - 4 + 2b + 9$ Group like terms.
$= 5b + 2b - 4 + 9$ Combine like terms.
$= 7b + 5$

c) $(6 - 3y) + (-3 - 2y)$ Remove brackets.
$= 6 - 3y - 3 - 2y$ Group like terms.
$= -3y - 2y - 3 + 6$ Combine like terms.
$= -5y + 3$

d) $(-n + 7) + (3n - 2)$ Remove brackets.
$= -n + 7 + 3n - 2$ Group like terms.
$= -n + 3n - 2 + 7$ Combine like terms.
$= 2n + 5$

e) $(-4s - 5) + (6 - 3s)$ Remove brackets.
$= -4s - 5 + 6 - 3s$ Group like terms.
$= -4s - 3s - 5 + 6$ Combine like terms.
$= -7s + 1$

f) $(1 - 7h) + (-7h - 1)$ Remove brackets.
$= 1 - 7h - 7h - 1$ Group like terms.
$= -7h - 7h + 1 - 1$ Combine like terms.
$= -14h$

g) $(8m + 4) + (-9 + 3m)$ Remove brackets.
$= 8m + 4 - 9 + 3m$ Group like terms.
$= 8m + 3m + 4 - 9$ Combine like terms.
$= 11m - 5$

h) $(-8m - 4) + (9 - 3m)$ Remove brackets.

$= -8m - 4 + 9 - 3m$ Group like terms.
$= -8m - 3m - 4 + 9$ Combine like terms.
$= -11m + 5$

9. I removed the brackets, grouped like terms, then combined like terms.

a) $(4m^2 + 4m - 5) + (2m^2 - 2m + 1) = 4m^2 + 4m - 5 + 2m^2 - 2m + 1$
$= 4m^2 + 2m^2 + 4m - 2m - 5 + 1$
$= 6m^2 + 2m - 4$

b) I removed the brackets, grouped like terms, then combined like terms.
$(3k^2 - 3k + 2) + (-3k^2 - 3k + 2) = 3k^2 - 3k + 2 - 3k^2 - 3k + 2$
$= 3k^2 - 3k^2 - 3k - 3k + 2 + 2$
$= -6k + 4$

c) I removed the brackets, grouped like terms, then combined like terms.
$(-7p - 3) + (p^2 + 5) = -7p - 3 + p^2 + 5$
$= p^2 - 7p - 3 + 5$
$= p^2 - 7p + 2$

d) I removed the brackets, grouped like terms, then combined like terms.
$(9 - 3t) + (9t + 3t^2 - 6t) = 9 - 3t + 9t + 3t^2 - 6t$
$= 3t^2 - 3t + 9t - 6t + 9$
$= 3t^2 + 9$

e) I removed the brackets, grouped like terms, then combined like terms.
$(3x^2 - 2x + 3) + (2x^2 + 4) = 3x^2 - 2x + 3 + 2x^2 + 4$
$= 3x^2 + 2x^2 - 2x + 3 + 4$
$= 5x^2 - 2x + 7$

f) I added vertically.

$$\begin{array}{r} 3x^2 - 7x + 5 \\ +\,-6x^2 + 6x + 8 \\ \hline -3x^2 - x + 13 \end{array}$$

Add the coefficients of like terms.

g) I added vertically.

$$\begin{array}{r} x^2 - 7x + 6 \\ +\,-6x^2 + 6x + 10 \\ \hline -5x^2 - x + 16 \end{array}$$

Add the coefficients of like terms.

h) I added vertically.

$$\begin{array}{r} r^2 - 3r + 1 \\ +\,-3r^2 + 4r + 5 \\ \hline -2r^2 + r + 6 \end{array}$$

Add the coefficients of like terms.

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10. The perimeter is the sum of the measures of all sides.

a) i)

$$\begin{array}{r} 2n+1 \\ +\ n+5 \\ +\ 2n+5 \\ \hline 5n+11 \end{array}$$

Add the coefficients of like terms.

The perimeter is $5n + 11$.

ii) Add the coefficients of like terms.

$$\begin{array}{r} 7r+2 \\ +\ 7r+2 \\ +\ 7r+2 \\ +\ 7r+2 \\ \hline 28r+8 \end{array}$$

The perimeter is $28r + 8$.

iii)

$$\begin{array}{r} 6t+5 \\ +\ 2t+1 \\ +\ 6t+5 \\ +\ 2t+1 \\ \hline 16t+12 \end{array}$$

Add the coefficients of like terms.

The perimeter is $16t + 12$.

iv)

$$\begin{array}{r} 3f+1 \\ +\ f+2 \\ +\ 3f+1 \\ +\ f+2 \\ \hline 8f+6 \end{array}$$

Add the coefficients of like terms.

The perimeter is $8f + 6$.

b) i) Choose a value for n, such as $n = 1$.
Write the addition sentence:
$2n + 1 + n + 5 + 2n + 5 = 5n + 11$
Substitute $n = 1$.

Left side:	Right side:
$2n + 1 + n + 5 + 2n + 5$	$5n + 11$
$= 2(1) + 1 + 1 + 5 + 2(1) + 5$	$= 5(1) + 11$
$= 16$	$= 16$

Since the left side equals the right side, the polynomial for the perimeter is correct.

ii) Choose a value for r, such as $r = 2$.
Write the addition sentence:
$7r + 2 + 7r + 2 + 7r + 2 + 7r + 2 = 28r + 8$
Substitute $r = 2$.

Left side:	Right side:
$7r + 2 + 7r + 2 + 7r + 2 + 7r + 2$	$28r + 8$
$= 7(2) + 2 + 7(2) + 2 + 7(2) + 2 + 7(2) + 2$	$= 28(2) + 8$
$= 64$	$= 64$

Since the left side equals the right side, the polynomial for the perimeter is correct.

iii) Choose a value for t, such as $t = 1$.
Write the addition sentence:

$6t + 5 + 2t + 1 + 6t + 5 + 2t + 1 = 16t + 12$
Substitute $t = 1$.

Left side:	Right side:
$6t + 5 + 2t + 1 + 6t + 5 + 2t + 1$	$16t + 12$
$= 6(1) + 5 + 2(1) + 1 + 6(1) + 5 + 2(1) + 1$	$= 16(1) + 12$
$= 28$	$= 28$

Since the left side equals the right side, the polynomial for the perimeter is correct.

iv) Choose a value for f, such as $f = 2$.
Write the addition sentence:
$3f + 1 + f + 2 + 3f + 1 + f + 2 = 8f + 6$
Substitute $f = 2$.

Left side:	Right side:
$3f + 1 + f + 2 + 3f + 1 + f + 2$	$8f + 6$
$= 3(2) + 1 + 2 + 2 + 3(2) + 1 + 2 + 2$	$= 8(2) + 6$
$= 22$	$= 22$

Since the left side equals the right side, the polynomial for the perimeter is correct.

12. The student is not correct; the error was made when combining like terms. $-7x - 5x = -12x$, not $-2x$; $3 + 9 = 12$, not 1.
The correct solution:
$(4x^2 - 7x + 3) + (-x^2 - 5x + 9)$
$= 4x^2 - 7x + 3 - x^2 - 5x + 9$
$= 4x^2 - x^2 - 7x - 5x + 3 + 9$
$= 3x^2 - 12x + 12$

15. Add a polynomial to $3x^2 + 7x + 2$ to get each sum.

a) $5x^2 + 10x + 1$
Think: $3x^2 + 7x + 2$
$+ \square x^2 + \square x + \square$
$5x^2 + 10x + 1$
By inspection, the polynomial must be $2x^2 + 3x - 1$.

b) $2x^2 + 5x + 8$
Think: $3x^2 + 7x + 2$
$+ \square x^2 + \square x + \square$
$2x^2 + 5x + 8$
By inspection, the polynomial must be $-x^2 - 2x + 6$.

c) $4x^2 + 3x$
Think: $3x^2 + 7x + 2$
$+ \square x^2 + \square x + \square$
$4x^2 + 3x$
By inspection, the polynomial must be $x^2 - 4x - 2$.

d) $-x^2 + x - 1$
Think: $3x^2 + 7x + 2$
$+ \square x^2 + \square x + \square$
$-x^2 + x - 1$
By inspection, the polynomial must be $-4x^2 - 6x - 3$.

e) $2x + 3$
Think: $3x^2 + 7x + 2$
$+ \square x^2 + \square x + \square$
$2x + 3$
By inspection, the polynomial must be $-3x^2 - 5x + 1$.

f) 4
Think: $3x^2 + 7x + 2$
$+ \square x^2 + \square x + \square$
4
By inspection, the polynomial must be $-3x^2 - 7x + 2$.

17. a) $(3x^2 - 2y^2 + xy) + (-2xy - 2y^2 - 3x^2)$ Remove brackets.
$= 3x^2 - 2y^2 + xy - 2xy - 2y^2 - 3x^2$ Group like terms.
$= 3x^2 - 3x^2 - 2y^2 - 2y^2 + xy - 2xy$ Combine like terms.
$= -4y^2 - xy$

b) $(-5q^2 + 3p - 2q + p^2) + (4p + q + pq)$ Remove brackets.
$= -5q^2 + 3p - 2q + p^2 + 4p + q + pq$ Group like terms.
$= -5q^2 + p^2 + 3p + 4p - 2q + q + pq$ Combine like terms.
$= -5q^2 + p^2 + 7p - q + pq$

c) $(3mn + m^2 - 3n^2 + 5m) + (7n^2 - 8n + 10)$ Remove brackets.
$= 3mn + m^2 - 3n^2 + 5m + 7n^2 - 8n + 10$ Group like terms.
$= m^2 - 3n^2 + 7n^2 + 3mn + 5m - 8n + 10$ Combine like terms.
$= m^2 + 4n^2 + 3mn + 5m - 8n + 10$

d) $(3 - 8f + 5g - f^2) + (2g^2 - 3f + 4g - 5)$ Remove brackets.
$= 3 - 8f + 5g - f^2 + 2g^2 - 3f + 4g - 5$ Group like terms.
$= -f^2 + 2g^2 - 8f - 3f + 5g + 4g + 3 - 5$ Combine like terms.
$= -f^2 + 2g^2 - 11f + 9g - 2$

18. a) Two sides of a triangle are $4x - 3y$ and $2x + y$.
$(4x - 3y) + (2x + y) = 6x - 2y$
The perimeter of the triangle is $9x + 2$.
Determine the polynomial you add to $6x - 2y$ to get $9x + 2$.

Think: $6x$ and what gives a sum of $9x$? The answer is $3x$.
There is no y-term in $9x + 2$, so eliminate $-2y$ by adding $2y$; $-2y + 2y = 0$
There is a constant in $9x + 2$, so add 2 to get the constant 2.
The third side of the triangle is $3x + 2y + 2$.

b) Choose a value for x, such as $x = 1$. Choose a value for y, such as $y = 2$.
Write the addition sentence:
$4x - 3y + 2x + y + 3x + 2y + 2 = 9x + 2$
Substitute $x = 1$ and $y = 2$.

Left side:	Right side:
$4x - 3y + 2x + y + 3x + 2y + 2$	$9x + 2$
$= 4(1) - 3(2) + 2(1) + 2 + 3(1) + 2(2) + 2$	$= 9(1) + 2$
$= 4 - 6 + 2 + 2 + 3 + 4 + 2$	$= 11$
$= 11$	

Since the left side equals the right side, the polynomial for the third side of the triangle is correct.

19. The perimeter of an isosceles triangle is $5y + 3x + 7$.
I find three polynomials that add up to $5y + 3x + 7$. Since the triangle is isosceles, two polynomials are equivalent.
Some possible side lengths are:
$(2y + 2) + (2y + 2) + (3x + y + 3)$;
$(y + 3) + (y + 3) + (3y + 3x + 1)$;
$(2y + x) + (2y + x) + (x + y + 7)$;
$(3) + (3) + (5y + 3x + 1)$

There are an infinite number of possibilities

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